SCIENCE.

FRIDAY, MAY 21, 1886.

COMMENT AND CRITICISM.

THOSE PEOPLE who have thought that Englishmen had already formed a society for every charitable purpose under the sun are now shown to have been mistaken. A society has just been organized for providing amusement for children. Of the eighty thousand children in London who leave the elementary schools every year, only four per cent have been willing to continue their education in the evening classes which have been provided by the education department. This unsatisfactory state of things has led to the formation of the Recreative evening schools association, whose object is to offer the children, who have been at work during the day, such an enticing evening programme that they will find it impossible to stay away. There are classes in musical drill, song, wood-carving, modelling, and drawing, with lessons in history, geography, and science, illustrated by the magic lantern. The idea is an excellent one. An education which 'children will cry for' is the ideal towards which education at all ages should approach as nearly as possible; and until that ideal is reached, the educational reformer will not find himself without an occupation. Sowing and reaping have not come any nearer in these days to being as great sources of enjoyment as foot-ball and tennis; but schools are very different from what they were when our fathers were young, and it is quite possible to hope that we shall learn in time how to give children a life of purely happy activity.

COMPLAINTS OF THE OVERCROWDING of the medical profession in the United States are constantly becoming more numerous, and there is certainly some ground for them. When the relatively greater increase in the number of graduates than of the population is taken into consideration, there is every reason to fear a far more severe struggle for existence as the lot of the average physician in the near future. Statistics give 3,675 as the number of medical students graduating in 1885, and the number will probably be increased the present year. Already the United States has a larger proportion of physicians to its population than any other country in the world, averaging one to less than six hundred. To keep up this proportion, taking into consideration the natural increase of population, an annual increment of but little more than two thousand annually would suffice for some years to come. It is evident that a large part of the yearly graduates must either drop out by the wayside, or struggle for a very moderate subsistence.

But for this actual and threatened overcrowding there is a remedy whose necessity and importance are fast being recognized; viz., stricter requirements on the part of the state and of the medical colleges. The requirements for graduation in many medical institutions have been disgracefully lax: a few months' attendance upon lectures, an oftentimes worthless certificate of study, an hour's superficial examination, and the candidate is admitted to the degree of doctor of medicine. But it is interesting to observe the appreciable effects of state legislation in this direction. No one factor has exercised so much influence in elevating the standard for medical graduation as the action of the Illinois state board of health. Illinois was a good place to begin, for no city in the world turns out more irregular practitioners than Chicago; and the board of health, by securing the passage of laws requiring the registration of physicians with evidence of fitness as shown by the possession of a diploma from some college of a given grade or by examination, has undoubtedly exerted wide-spread influence. The number of graduates in 1885 was less than in 1884; and nearly every college, ostensibly at least, now requires a preliminary examination; and not a few have raised their standard of requirements for graduation, and lessened the number of their graduates.

THE SUBJECT of industrial education in common schools has been often broached of late, and any able work upon it is sure to attract attention. There lies before us a pamphlet on this subject by H. H. Dinwiddie of the Agricultural and mechanical college of Texas; but we are compelled to say that it sheds no new light on the

question. The author thinks the times are out of joint; and he is grieved that so many men have difficulty in earning a living. "The benevolent heart," he says, "is tortured by the cruel deliberation of natural selection, with its inexorable logic." "Shall thousands of young men walk the streets of our cities with their high commencement-day hopes ever sinking, till despair and gnawing hunger throw over every noble aspiration, and drive them to lives of infamy or death by suicide?" The conclusion is, that, if the young were taught the methods of industry at school, they would afterwards have no trouble in earning their living. We expected, therefore, to find the author advocating the teaching of mechanical trades in the common schools, as many others have done. As a matter of fact, he doesn't advocate industrial training at all: he only advises that the methods of the various industries should be described to the students, just as objects in natural history are described, but without any manual practice by the students themselves. How this is to help them in earning a living, we are unable to see; but it is the sole outcome of Mr. Dinwiddie's pamphlet.

THE INTELLECTUAL MOVEMENT IN JAPAN.

EVERYBODY in America who knows at all that there is such a country as Japan in the far east ought to be aware by this time that great social changes have for a past decade or two been going on among us. And numerous books and articles on Japan which have appeared within recent years in America, ought to have made tolerably clear of what nature these changes are. Thoughtful persons must often have wondered from afar whether these reforms are permanent, whether the spirit of progress does not lag sometimes, whether the people who seem to be rushing on with a headlong pace do not at times look back with longing on their past. If such persons had taken the trouble to look into the matter three or four years ago, they would have discovered that their surmises were correct. At that time we seemed to have turned round suddenly in the path which we had been so eagerly pursuing. People had started with the idea that all things European were good, and all things Japanese were bad. As they went on trying one sweeping change after another, they began to discover naturally that there were many blots in the European form of civilization, especially as imported into oriental countries, and that many things Japanese were not bad at all, but excellent, and even surpassed their European counterparts. This discovery, helped also, to some extent, by compliments, which foreign visitors are ever willing to pour on us, carried the people's feeling to the opposite extreme. They said to themselves, "We are not so very bad, after all. Why should we change? Let us have back our own familiar ways and things." The revival of old things became the order of the day. Chinese ethics began to be studied again with fervor, and the doctrines of Confucius and Mencius reigned supreme once more in the moral world. There was a revival of old Japanese literature and traditions. Women were to be brought up in the old-fashioned strait path: they were not to be allowed to catch hold of any new-fangled European ideas. *Utai* (a peculiar kind of singing) was heard again on all sides, and brought back old associations. Teachers of *cha no yu* (the art of making tea, including all the formalities attending its drinking, etc.) were in requirement on every hand, while masters of the Ogasawara school of etiquette bustled along with smiling countenances. The fashion was to give banquets in the old Japanese style, and restaurants *à la europienne* felt it to be very hard times. Young men were seen on the street, carrying about fencing-apparatus, — a sight not seen since the old feudal days. Schools of *jū jitsu* (a kind of wrestling) sprang up into existence by dozens. Various weapons of the *saumrai* which had been hung up in dark corners, again saw the light, and each claimed its own votaries. In short, all reforms seemed to be at an end for the present.

It must not be supposed, however, that all these carried us very far back. The backbone of old Japan — feudalism — had been shattered beyond all hopes of recovery; and, without that, things could not be made to work as in former days, however much minor matters might be patched up. Neither did people care to go back quite so far. Those who looked beneath the surface could easily see that this period of reaction could offer but a temporary check in the way of reforms, being comparable simply to the rest-stages observable during earlier developmental phases of many an animal. In fact, it proved to be of a very short duration. And who shall regret that there was just at that time partial retracing of the path we had been following, since it will prove to be the means of preserving many harmless arts and accomplishments peculiar to Japan, which might otherwise have been lost forever?

At the present time we may be said to be fairly in the midst of the second period of activity. We seem to be just as eager as ever to pursue the course of reforms; perhaps a little more so, for

the short respite we have had. The reforms that were accomplished in the first period were in many respects but superficial and material, or concerned only larger affairs of state; as, for instance, the establishment of telegraphic and postal service, opening of steamship lines, reorganization of the army and navy, reforms in the method of administering justice or of managing schools. They have left the feelings and thoughts of people comparatively untouched so far; but such stupendous changes could not take place without producing profound effects on the national life. And the present aspect of things makes it seem likely that during this second period of activity there will be great transformations in the innermost life of Japan. There will come to be healthier and sounder views in regard to family ties; and some, at least, of the abuses which disfigure the domestic life, we may hope will pass away. Woman's position will be better, and the gentler half of the nation will gradually come to exert more influence in society. New ideas will penetrate even to the very hearth-stone — or, rather, will lead to the establishment of a great institution known as the 'hearth,' which plays such an important part, both materially and metaphorically, in the life of Europe and America. The result of all these and other reforms will be to draw the Japanese closely into the comity of nations, and to make us share the feelings and thoughts of the civilized world, and to let the civilized world share our thoughts and feelings. In the opinion of many, we shall surely go down, if we could not accomplish this: it is our only chance of survival in this world of keen struggle, which seems to be raging just now in this part of the globe with more bitterness than elsewhere.

Of the reform movements which have been started since the last period of reaction, none is likely to be more beneficial, or more wide-reaching in its effects, than the movement initiated by the Roman alphabet association (*Roma-ji-kai*). This society has for its object nothing less than a complete revolution in the manner of writing the Japanese language. It proposes to substitute the twenty-six letters of the Roman alphabet in place of Chinese ideographs now used. To understand the meaning of this movement, we must explain how Japanese has been and is being written. In more formal kinds of writing the classical Chinese style is adopted. Chinese ideographs alone are used, and sentences are constructed as in pure Chinese. A scholar of that country will have no difficulty in understanding it. It must not be supposed, however, that a Japanese reads this in the way a Chinese would. A sentence being composed simply of a series of symbols, each of which stands for an idea, a Japanese translates it offhand, and reads it in Japanese, giving to each word its appropriate case-endings or inflections, which are not at all to be seen in the writing. This style of writing is now used much more sparingly than in former days. The most prevalent form of writing at the present day is a mixture of Chinese ideographs with the Japanese *Kana* syllabary; that is, ideographs are used to represent principal ideas in a sentence, and what might be called connectives are given in *Kana*. For instance: in the sentence, 'A dog killed a cat,' the main ideas conveyed by the words 'dog,' 'cat,' and 'kill,' are given in Chinese ideographs; while the particles that make the word 'dog' the subject, and the word 'cat' the object, of the sentence, are given in *Kana*, as well as the tense-endings of the word 'kill.' A small part of literature especially meant for the illiterate is in the Japanese *Kana* only.

Such being various methods of writing our language, it is absolutely necessary for a Japanese to learn a few thousands of Chinese ideographs before he can read or write at all fairly. And be it understood that to know the meaning of each character is not enough. To get at the complete natural history of an ideograph, one must first of all know, of course, its meaning or meanings. Then he must know the sounds which the Chinese gave to it. Of these, each character has at least two, — the sound it had when it was first introduced into Japan from Corea, the *go*-sound; and that which it had in a certain part of China when some Japanese visited it some centuries later, the *kan*-sound. Then he must know various ways in which this ideograph is written, — the printed, the 'cursive,' the 'grass' forms, — for, in writing, each ideograph is not generally given with its regular and full strokes, but is somewhat abbreviated. If there can be unreadable handwriting with only twenty-six letters to work with, imagine what it must become when there is a chance of mangling thousands. In addition to all this, every respectable person has to write ideographs with some degree of decency; with power and feeling, if possible, for penmanship almost amounts to painting, and does actually have, in the eyes of many, an equal value with it as an art. The simple task of mastering writing and reading becomes thus no mean one. If there were any proof needed of this fact, beyond the mere statement of the case, it lies in the fact that numerous as are the foreigners who have lived in Japan, and have fairly, or in some cases perfectly, acquired the spoken language, those who have mastered writing and reading can be counted on one's fingers.

When it is remembered that for a Japanese who wishes to keep abreast of the world, and to become acquainted with modern learning, the additional knowledge of at least one, or, if possible, of two or three, European languages is absolutely essential, thoughtful persons may well pause, and ask what time there is left for us for mastering many arts and sciences which go to make up modern life. In this world of keen struggle for existence, shall we not necessarily lag behind all other nations, if we are so occupied with mere symbols, and not with ideas themselves? That this state of things is most undesirable is admitted on all sides. In former leisurely days, when learning was a luxury in the hands of a privileged few, the harder it was made, the better. But we are now in the days of universal education, and what can we possibly accomplish with this clumsy and ponderous machine of bygone days? Clearly, something must be done, and this quickly. That such is the opinion held by all intelligent persons, there can be no doubt. The question is, what is to be done?

Some years ago a movement was started by which it was proposed to dispense with Chinese ideographs altogether, and to use the Japanese *Kana* syllabary only. The *Kana-no-kai* (the *Kana* association) was formed. The association has some three or four thousand members, and has done very good and earnest work, although, of late, eclipsed to some extent by its younger sister, the Roman alphabet association.

If the *Kana* alphabet alone should be used, it would certainly be a great improvement on the present method of writing Japanese with Chinese ideographs; but, in the opinion of many, the *Kana* is not equal to the demands of modern life. Springing originally from Chinese ideographs, it partakes somewhat of their clumsiness. A printed page of *Kana* is frightfully monotonous; there are no strokes that project out above or below the average width of letters; and taking in a word at a glance, without going over its component letters, is rather difficult. Again: although phonetic to some extent, spelling in it is really as bad as that of English words. There are many ways of writing down the same sound, and to know how a given word should be spelled becomes very difficult. For instance: there are eight different ways of writing the sound *Kō*, the same number of ways in writing *ō*, four ways of putting down the sound *mō*, five ways of writing *rō*, etc., and these are by no means exceptional cases. Think of the word *chō-chō* being written *tefu-tefu*. It is very difficult to write a scientific treatise in Japanese, anyway; but it is doubtful if it is possible to do so in *Kana* at all. The few attempts that have been made so far must be pronounced failures. The *Kana* alphabet has no doubt the merit of being known almost universally, and it is certainly at the present day the best vehicle of propounding simple ideas to the masses. But unless radical reforms are carried out in the method of writing in it, and several more symbols are newly added, it is not, in my opinion, equal to the demands of modern civilization.

The Roman alphabet has, on the contrary, all the facilities of the *Kana*, and possesses several additional advantages besides. Its twenty-six letters are very easy to learn, and its adoption will make reading and writing a very simple task; in fact, almost nothing compared with the present method of using Chinese ideographs. It will, of course, cause education to spread wider. It will save several years in every schoolboy's life. Those which he has to spend in the drudgery of learning how to read and write, he will be able to give to acquiring solid ideas of modern knowledge. The adoption of the Roman alphabet will also make the introduction of scientific terms and symbols into our language very easy. They have simply to be transferred bodily, with only such changes as the nature of our language makes imperative. Think what this means in mathematics, physics, and chemistry, or in writing down the scientific nomenclature of zoölogy, botany, and mineralogy. Geographical names and other proper nouns can be put down accurately, and not in imperfect approximations. Last but not least, the Roman alphabet being the one in which the literature of the civilized world is written, familiarity with it will make the acquisition of European languages comparatively easy; and, if Japanese be written in it, foreigners will have no difficulty in mastering reading and writing our language,—a task which they find now so utterly impossible. Thus the adoption of the Roman alphabet will help us to know others, and help others to know us. In short, it will make us kin with the rest of the world.

All this has been reasoned out time and again by persons who gave thought to the subject. But the stupendousness of the task of revolutionizing the whole written language of a nation deterred any from taking practical steps, and it is a matter of doubt whether any such attempt made before its own time would not have been laughed down. But when the period of reaction referred to in the beginning was over, and the march of reforms was resumed with as much eagerness as ever, the time seemed to many to have come for starting the movement of introducing the Roman alphabet as the means of writing our language. Every

thing seemed ready, especially as the *Kana-no-kai* (the *Kana* association) was already in the field, and making the urgency of radical reforms in the mode of writing a familiar idea to everybody.

The Roman alphabet movement originated principally within the University of Tokio. The first meeting for the purpose of organizing an association to carry on the movement was called on Dec. 2, 1884, at which seventy persons were present. The work of organization was completed early in the following January. A committee of forty, including several well-known foreign scholars, was then appointed to draw up a scheme of transliteration (adapting Roman letters to our sound). As Japanese does not contain any very peculiar sound, this task was comparatively easy, although it was not until after some heated discussion that the committee could come to a decision. The committee, wisely it seems to me, seized on what was already in vogue, — for of course Japanese had been written with the Roman alphabet before this,— and fixed it into a convenient and simple scheme. The system adopted is very much like that of Dr. Hepburn, the venerable American missionary who published some years ago a Japanese-English dictionary. With the completion of a transliteration scheme, the Roman alphabet association, or *Roma-ji-kai*, as it called itself, was in fair working-order. Its publications, setting forth its objects or explaining its scheme of transliteration, were cast broadside. The association was received with enthusiasm, and was a great success from the first. In June, 1885, — that is, six months after its organization, — its members numbered 2,904 persons; in December of the same year, 6,202 persons; and at the present date of writing, the membership is about 7,000. These belong to all parts of the country, and are from every station in life, from cabinet-ministers to story-tellers. In the first meeting, held in December, 1884, there were present only 70 persons. In the general meeting, held in January of the present year, the large Central hall of the Engineering college in Tokio was filled. At least 1,200 persons listened to interesting addresses made on that occasion by Count Inouye, the minister of foreign affairs, and by the Hon. F. R. Plunkett, the English minister in Japan. The association publishes a monthly magazine, named *Rōmaji Zasshi*, and distributes it gratis among members. It contains essays on all sorts of subjects by well-known writers, besides the transliterations of extracts from popular books. In it the entire practicability of writing Japanese with the Roman alphabet has been demonstrated. The association is also having a Japanese dictionary compiled.

Some of the newspapers make a practice of printing a small part of their issue in Roman letters, and thus aid in familiarizing people with it. In some provinces local societies have been organized to cultivate the use of the Roman alphabet.

The movement is likely to make its way fastest among scientific publications. Already the Tokio physico-mathematical society publishes its proceedings in the Roman letters.

Stupendous as is the task which the Roman alphabet association has before itself, its friends are sanguine that it will accomplish its purpose. The prospects are very favorable in every respect. For instance: the Department of education some time ago sanctioned the teaching of English in primary schools. The knowledge of English, of course, implies the knowledge of reading and writing Japanese in the Roman alphabet. Let the Roman alphabet be taught in public schools, and in a generation or two we shall have accomplished the desired reform. If the change were toward any thing very difficult or disagreeable, it might be hopeless. As things are, however, the prospects are very bright.

From the first, foreigners have been in favor of the movement, and have furnished some very useful and active members. Altogether several hundred, including diplomatists, editors, missionaries, teachers, scientific men, are enrolled in its membership list. The association has also received pleasant recognition abroad from newspapers and societies. Conspicuous among this stands the action of the London philological association. At the meeting held Dec. 18, 1885, that learned body passed a resolution of sympathy with the Roman alphabet movement in Japan, moved by Dr. Furnisvall, and seconded by Professor Skeet, the president, and Henry Sweet, the philologist.

The Roman alphabet association has thus accomplished a great deal in one year of its existence. As in all similar undertakings, it suffers from lack of funds. This alone limits the sphere of its activity and usefulness. K. MITSUKURI.

Tokio, April 23.

THE AMERICAN CLIMATOLOGICAL ASSOCIATION.

THE third annual meeting of the American climatological association was held at the College of physicians, Philadelphia, May 10 and 11, Dr. William Pepper presiding. The opening address of the president was devoted to the subject of the distribution of phthisis in Pennsylvania. The president reviewed the results of similar investigation by Dr. Bowditch in Massachusetts. Dr. Bowditch had found a remarkable correspondence

to exist in Massachusetts between the death-rate from phthisis and the dampness. Dr. Pepper had conducted a similar investigation in regard to Pennsylvania by means of a series of questions addressed to physicians throughout the state. The answers received were somewhat meagre and unsatisfactory, but were sufficient to show certain remarkable facts. The relation between phthisis and dampness was not so clearly shown as in the case of Dr. Bowditch's investigation. As a general rule, the counties of high elevation and sparse population made the best showing. The most striking fact, however, was the remarkable correspondence between the areas of least death-rate from phthisis and the areas of standing hemlock : they seemed to be almost exactly coterminate. In those towns where the mortality was found to be low, the death-rate was increased in those parts which lay along rivers and in swampy regions, and where the cellars of the houses were damp. The direction of the prevailing winds seemed to have no bearing upon the amount of phthisis. The opinion of the physicians addressed in regard to the influence of heredity in phthisis appeared to be almost unanimous, only 7 out of 94 denying it.

Dr. A. L. Loomis read a paper upon the effects of high altitude on cardiac disease, in which he reported several cases of various cardiac disorders, where a sudden change to a high altitude seemed to hasten the fatal event. The doctor advocated extreme caution in making such changes.

Dr. I. H. Platt of Brooklyn read a paper upon the physics and physiological action of pneumatic differentiation, the purport of which was that the action of the pneumatic cabinet was similar to that of compressed-air apparatus, and that no more medicated vapor or spray can be carried into the lungs with the aid of the differential process than without it. The author believed the beneficial result of treatment by this method to be due to the reduction of congestion by the increased atmospheric pressure in the lungs and by the strengthening of the thorax by exercise, as well as to modified nutrition consequent upon the changes in the respiratory and circulatory functions.

Dr. Roland G. Curtin contributed an interesting paper upon the subject of Rocky Mountain fever. The fever commences with a chill, and a rise of temperature to 101 or 102, without the remission of typhoid. The skin is dry. The temperature may fall suddenly and rise suddenly. Quinine seems to be powerless. Delirium may occur, but it is not usual. There is no definite duration to the disease, and its tendency is to recovery : the absence of fatal cases prevents a knowledge of the pathology. The question seems to be unsettled, whether it is a separate disease, or a light form of typhoid.

A very important paper was presented by Dr. C. C. Rice, "How the therapeutic value of our mineral waters may be increased." The fact of so many patients going to the European springs to the neglect of the American is partly the fault of the medical profession in this country, and partly the fault of the owners of the springs. Americans are less acquainted with our own springs than with those of Europe. It is important, that, if the waters are used at all, they should be used intelligently. The general hygiene should be under the direction of a physician.

One of the factors which go to make the European watering-places famous is the mental effect of the vigorous course of training there in vogue. Contrasted with this is the social life at Saratoga and Richfield springs. People go to Carlsbad, not for fashion, but for the waters. The habits at the European watering-places are simple. American springs should be more thoroughly investigated by the profession, and the waters should be given their proper place in the materia medica. He offered the following suggestions in regard to the development of our springs: 1. Analyses of the waters should be made by competent chemists ; 2. Clinical investigation of the waters should be made by physicians ; 3. Care should be taken to select the special spring adapted to the case ; 4. A careful history and diagnosis of the case should be sent with the patient to the local physician ; 5. More rigorous discipline should be enforced ; 6. Patients should be compelled to abstain from fashion and social dissipation.

Dr. Didima read a paper upon the health-resorts of Mexico. His paper was based upon communications from Mexican physicians, which were somewhat contradictory ; but the facts seemed to be that the climate of Mexico was naturally favorable for the relief of phthisis, but its beneficial effects were offset by its lamentable lack of sanitary arrangements. Another drawback to the climate is the great difference between the temperature in the sunshine and in the shade.

'The southern Adirondacks' was the title of Dr. E. F. Bruen's contribution, who was a warm advocate of Blue Mountain Lake. This lake is surrounded by pine-forest, and the air is so pure that no dust is visible in the beams of sunlight. But little rain falls in the winter.

Dr. J. H. Musser discussed the question of the prevention of phthisis among mill-hands, and advocated the extension of the plan adopted by the Willimantic thread company, of supplying the mill-hands with wholesome and nutritious food,

which the experience of this company has shown to be advantageous from a financial as well as a humanitarian stand-point.

Dr. Dana discussed the relation of high altitudes to nervous diseases. He had investigated the subject by means of questions addressed to physicians in various elevated stations, and arrived at the following conclusions: choreiform manifestations are increased by high altitudes; nervousness and irritability are also increased; nervous women especially are rendered more nervous; the weight of opinion seems to be that old age is not prolonged by altitude; epilepsy is not increased, sometimes the patients improve; insomnia is usually benefited, often cured; the gouty diathesis is not helped by the change.

The officers for the coming year are, president, Dr. Frank Donaldson of Baltimore; 1st vice-president, Dr. V. I. Bowditch of Boston; 2d vice-president, Dr. R. G. Curtin of Philadelphia; secretary, Dr. J. R. Walker of Philadelphia.

PROGRAMME OF THE INTERNATIONAL PHILOMATHIC CONGRESS.

THE International philomathic congress, having for its object the discussion of commercial and industrial technical instruction, and opening Sept. 20, 1886, has arranged the following programme of questions for discussion: I. General questions: Present condition of commercial and industrial technical instruction in France and abroad; domain of this instruction; importance due it; its influence on the economic, commercial, and industrial condition of the country; general view of an organization of technical instruction; preparation for the various branches of this instruction; action of the state, general councils, municipalities, chambers of commerce, consulting chambers, syndic chambers, and private corporations; on the establishment of schools of technical instruction; on the elaboration of their methods and courses of instruction; on their government; on their financial organization; to what extent should technical instruction be provided with a general and uniform course? to what extent should it have special courses appropriate to the necessities of each district? what position should be allotted in the different schools of technical instruction to general instruction? what proportion is to be allotted to theoretical and what to practical instruction? relations among themselves of similar schools of technical instruction, with a view to common action respecting all general measures intended to aid their development, and assure their prosperity; concerning their representation in the superior council of technical instruction; periodicity of the congress for technical instruction; place and state of the next congress. II. Special questions: organization of commercial technical instruction, first degree (elementary commercial instruction), second degree (more advanced commercial schools), advanced degree (advanced commercial studies); organization of industrial technical instruction, first degree (workmen), second degree (master workmen and foremen), advanced degree (engineers); preparation and admission of the pupils; instruction by the master workmen; apprenticeship; schools; laws and regulations, courses, and methods; theoretical instruction and practical instruction; instruction in drawing; manual labor; staff of administration and instruction; councils of administration and improvement; buildings and material; plans and distribution of the buildings; instruments and material for instruction; libraries; commercial museums: industrial museums; financial organization; fellowships; scholastic excursions and expeditions; travelling fellowships and resident fellowships abroad; finding places for pupils after graduation; places and salaries; complimentary courses of technical instruction; courses for apprentices and adults; public lecturers. All information relating to the congress may be had of the general secretary of the Philomathic society at Bordeaux, Eugene Buhan.

NOTES AND NEWS.

WE have received a pamphlet of fifty-one pages on the Pennsylvania boroughs, which may interest some of our readers. It is written by William P. Holcomb, and forms one of the studies in historical and political science published by the Johns Hopkins university, the fourth series of which is now under way. The author begins with an account of the introduction of the borough system under William Penn, and then sketches the history of some of the leading boroughs, and concludes with a description of the borough system as it now exists. This method of local government is only found in three American states, — Pennsylvania, New Jersey, and Connecticut, — and citizens of other states have some difficulty in understanding what a borough is, and wherein it differs from a city. According to Mr. Holcomb, the difference is mainly one of size, ten thousand inhabitants being required, under Pennsylvania laws, to constitute a city, while a borough need not have more than a few hundred. Then a city in that state has two representative councils, while a borough has only one; and these two points, with a few differences in names, seem to be the only distinction between the two kinds of

municipalities. The author expresses some surprise that boroughs, which are so common in England, should be so rare in the United States; but, if they differ so little from cities, there would seem to be no particular need of them. Mr. Holcomb's work will doubtless be useful to Pennsylvanians and to students of municipal government generally.

— The U. S. coast survey has issued a new edition of the chart of Humboldt Bay, made from the most recent surveys; the third edition of appendices 12 and 13 of the report of 1882, on magnetic declination, by assistant Schott; the latest chart showing the entrance to New York harbor; and the tenth sheet of the District of Columbia map, made under the direction of the Corps of engineers by Assistant Doun. A new chart of St. John's River, Florida, from its mouth to Jacksonville, is in course of preparation. The New York bay entrance sheet, 8 A, is now ready for distribution to dealers.

— The Boston medical-school circles are at present agitated over the question whether the female medical students shall be allowed to attend the general surgical clinics in the city hospital, they having insisted upon that privilege by attending, and refusing to withdraw.

— The German secretary of state has published statistics on the periodicals of the world, from which it appears that there are 34,000, with a distribution of 592,000,000 copies; 19,000 are published in Europe, 12,000 in North America, 775 in Asia, 809 in South America; 16,500 are in English, 7,800 in German, 3,850 in French, and 1,000 in Spanish.

— MM. H. Fal and E. Sarasin, in a recent communication to the French academy of sciences, have supplemented their researches on the penetrability of light in deep water by the results of a series of observations in the Gulf of Nice, showing the relation that exists between the vertical and oblique rays of the sun in their power to reach to great depths. They found the limit of luminosity to be four hundred metres in mid-day of April, and that only for a short time. At eight o'clock in the morning its penetrability was limited by three hundred and fifty fathoms; at six o'clock in the afternoon the light reached less than three hundred metres.

— For a number of years past the city of Liverpool has been engaged, at much cost and trouble, in the perfection of her sewerage and house-drainage systems. The works are only just completed, but already very distinct results are evident in their influence upon the city's mortality. For the ten years prior to 1870 the death-rate per thousand of the inhabitants was no less than 32.5; between 1870 and 1880 the mortality had fallen to 28.4; and since then a steady and uninterrupted fall has been maintained, until, during 1885, it only reached 23.5.

— It is stated in the daily papers that Prof. J. Emerick of William and Mary college has discovered the aerolite which fell in Washington county, Penn., on Sept. 14, 1885. It was found embedded deep in the soil near Claysville, and is said to weigh fully two hundred tons, — a statement that needs confirmation.

— The members of the Chesapeake zoölogical laboratory of Johns Hopkins university left Baltimore on Thursday, the 20th of May, for Abaco, one of the islands of the Bahama group, where the summer session of the laboratory will be held. The party consists of Prof. W. C. Brooks (the director), Professor Mill, Dr. H. Orr, Messrs. E. A. Andrews, F. H. Herrick, H. V. Wilson, and two or three other students of Johns Hopkins.

— A favorable report has been made by the house committee on agriculture on the bill to amend the act creating a bureau of animal industry. The most important change is in section 1 of the present law, which is to be entirely repealed. The substitute offered proposes that the chief of this bureau shall be a competent veterinary surgeon, who is to investigate the condition of the domestic animals in this country, and inquire into the causes of contagious, infectious, and communicable diseases among them, and the means for the prevention and cure of the same. The bureau is further instructed to make special investigations of pleuro-pneumonia, foot and mouth diseases, and rinderpest in cattle. Two hundred and fifty thousand dollars are to be appropriated to carry into effect the provisions of the act.

— The first shipment of shad to the Pacific coast by the U. S. fish commission has resulted most successfully. Car No. 1, which left Washington last week in charge of Mr. J. F. Ellis, with a million young shad, arrived at Portland, Ore., with seven hundred thousand. This experiment of transporting shad so great a distance proves the practicability of shipping them in this way. Of greater interest to science, however, was the successful experiment of hatching the shad *en route.* Six hundred thousand eggs formed a portion of this western shipment, which were placed in four MacDonald jars. A pump was kept continually at work, moving the water, and fully ninety-five per cent of the eggs were hatched. Of the five per cent lost, most of them were due to premature

hatching. This is a most gratifying showing for the fish commission, which is constantly discovering and applying new methods in the science of fish-culture.

— The following comprise the recent changes in the coast survey service. Parties on the Pacific coast have all taken the field under instructions. Professor Davidson is at Portland, Ore., observing for telegraphic longitude, while Assistant Pratt is at Tatoosh Island, which point is made available as a telegraphic longitude station, from the fact that the U. S. signal service now has wires in operation from Port Angeles to that point. Assistant Whiting takes the field about June 1 in Massachusetts, to determine the changes at Cotamay, Martha's Vineyard. Assistants Smith and St. Clair are between Colorado Springs and Salt Lake City, engaged in telegraphic longitude determination. Parties in the south will shortly be closing their season's work, and will report to the Washington office for future field-duty. The geographical positions of the Borden survey of the state of Massachusetts, together with a great number of additional points determined by the coast and geodetic survey, computed upon Clark's spheroid, are ready for publication in the annual report for 1885.

— A report just received from the U. S. consul at Apia gives the following as the copy of a card found inside a bottle picked up on Palmyra Island, Nov. 26. 1885 : "R. M. Str. Zealandia from San Francisco to Sydney, Lat. 7° 30′ N.; Long. 163° 30′ W." This bottle had drifted a hundred and one miles south by east.

— In Holland, where the public-school system has reached a very highly developed stage, it is now proposed to relegate primary education to the private schools. A measure to that effect has passed the lower chamber of the states-general, and has been withdrawn by the government for the purpose of removing certain objectionable features which caused its rejection by the upper house.

— The coldest place upon the earth, says *Ausland*, is Verchojansk, in Siberia. The coldest regions of Asia lie east of the Lena River, and the meteorological station at Yakootsk has recorded the lowest temperature ever observed. The average temperature for the year at that place is −17° C., and the difference between the summer and winter temperatures is not less than 64° C.; the average temperature in January being −49° C., and in July, +15° C. On Jan. 15, 1885, the temperature fell to −68° C.

— Recently published statistics of British India give the entire population (for 1883–84) at 253,982,595, and the superficial area at 1,378,044 square miles. 43,549,158 residences were enumerated. The density of the population reaches its maximum in Bengal, where there are 442.8 inhabitants to each square mile : the minimum is found in Central India with 59.3, and in British Burmah with 42.8, to each square mile. For every 130 males there are 124 females. The Hindoos and Buddhists include 190,000,000; the Mohammedans, 50,000,000 ; Christians, 1,800,000 ; Parsees, 85,000 ; Jews, 12,000 ; and various other sects with smaller numbers. The entire debt of India amounts to £171,577,945. In March, 1885, the entire length of railroads, in miles, was 12,000 ; of the telegraph systems, 23,341; the total length of wires, 68,694.

— A canal between the White Sea and the Baltic Sea has been determined upon by the Russian authorities, says *Ausland*. Peter the Great long ago busied himself with such a project, which only lately was revived by the Russian society for the promotion of commerce and industry. The cost, which is estimated at seven million rubles, will be borne by the state. Work will be begun upon the canal the present year.

— Statistics of the French sea-fisheries, for 1884, recently published, give the total value of the catch for that year at 87,961,124 francs, — a decrease from that of the previous year of 19,265,797 francs.

— Dr. Valentine Mott, who went to Paris some months ago to study Pasteur's methods of hydrophobia treatment, has just returned, very sanguine in his belief of its efficacy. He brought with him, on his return, a rabbit inoculated by Pasteur just before his departure. The rabbit died on the seventh day after receiving the virus, a short time before coming into port. This is said to be the first time that Pasteur has given the virus to any one, and it will be utilized for further propagation and hydrophobia treatment by Dr. Mott.

— One of the oldest medical colleges, if not the oldest, in the world, is the Medical school of the Imperial university of Japan, which now numbers its centuries by two figures. In its earlier period its faculty included a superintendent and assistant, one professor of medicine, one of acupuncture, one of massage, and various other instructors in special diseases, materia medica, botany, etc. The course then covered seven years, and even now the school shows a more creditable status than the most of ours. Four years in actual medical studies are now required, with three years' preparation, — in all, seven years of college training. We wonder whether the profession in

America would be crowded as badly as the universal lamentations of medical men indicate, if all were excluded from practice, save those who had spent seven years in preparation. The course of instruction at the Japanese college is modelled after that of the German schools, and the lectures are mostly delivered in the German language, by the five foreign professors, though there is a special course in the Japanese. The total number of students in attendance last year was nine hundred and seventy-two.

— Messrs. W. T. Jackman and J. D. Webster have lately succeeded in obtaining good photographs of the retina of the living human eye, illustrations of which are given in the English *Photographic news*. They were able to bring the time of exposure for the negative to within two minutes and a half, and it is very probable that technical skill will further reduce the time and difficulties. The chief obstacles to shortening the time of exposure, so far encountered, are the color of the retinal reflection, and the fact that the lens of the eye has the property of absorbing the ultra-violet rays. It seems highly probable that the photograph will here become a valuable adjunct to the physiologist, ophthalmologist, or even the general physician, as the eye affords diagnostic aid in not a few diseases.

— C. Wiegelt, O. Sacre, and L. Schwab have made a series of very valuable experiments, says the *Chemical news*, on the injury to fisheries and fish-culture by sewage and industrial waste waters. They find that chloride of lime, in proportions of 0.04 to 0.005 per cent chlorine, has an immediate deadly action upon tench, while trout and salmon perish in presence of 0.0008 per cent of chlorine. Sulphurous acid has the same action as chlorine, and is still more hurtful if another acid is simultaneously present; sulphites are harmless. Hydrochloric acid, 1 per cent, kills tench and trout. In sulphuric acid of 0.1 per cent, trout turn on their sides in two to six hours, while tench were not affected in eighteen hours. Acids are said to have less action, the higher are their molecular weights. Tannin at 0.1 per cent is harmless. Ammonia exerts no action at 0.01 per cent. Soda at 1 per cent is fatal to trout on prolonged exposure. Manganese chloride at 5 per cent had no action on tench in twenty-two hours, and a trout sustained 1 per cent for five hours. Iron acts as a specific poison upon fishes, except in the state of a ferrous salt. Alum has the same injurious action as the salts of iron. Solution of caustic lime has an exceedingly violent action upon fishes, due in part to the deposition of calcium carbonate in the gills. Arsenious acid, 0.1 per cent, combined with soda, has no injurious action upon trout and tench. Mercuric chloride, in proportions of 0.1 and 0.05 per cent, is immediately fatal. Copper sulphate, 0.1 and 1.0 per cent, kills trout in a few minutes if they cannot escape into pure water. Potassium cyanide, 0.01 and 0.005 per cent, is rapidly fatal if there is no escape. Potassium sulphocyanide and ferrocyanide, in the proportion of 1 per cent, had no injurious action in an hour. Sodium sulphide, 0.1 per cent, was endured by tench for thirty minutes. The fish were bleached, and did not recover their color in pure water. Hydrogen sulphide proved rapidly fatal in the proportions of 0.01 and 0.001 per cent. The hurtfulness of putrid sewage depends on poisonous gases, on the deficiency of oxygen, and on the action of bacteria.

— The death is announced of Mr. Thomas Edwards, the Scotch shoemaker naturalist whom Dr. Smiles made famous.

— In an article on coal-consumption as affected by temperature and length of trains, the *Railroad gazette* reaches some interesting conclusions. Dead weight to the amount of thirty tons added to a train of, say, five cars, will not increase coal-consumption as much as to add another car, both because it does not increase air-resistance and because the added load decreases somewhat the rolling resistance per ton. If we assume it to add five pounds per mile to the coal-consumption, we are certainly not underestimating it proportionally. Adding six tons per car, therefore, to the average weight of a train of five passenger-cars, means no more than an increase from fifty-five to sixty pounds per train-mile. If we assume this five pounds of coal to be worth one cent (at the rate of four dollars per ton of two thousand pounds for coal), and if an extra passenger at three cents per mile be attracted to the train every third trip, he will pay for the loss of fuel due to adding six tons to the weight of every passenger-car, which goes a little way toward explaining the tendency to increase weight for the sake of luxury, which seems so reckless. In this estimate, the effect of extra weight on grade-resistance is taken into account, though in reality it is comparatively unimportant. It is estimated that about six pounds and a half of coal per mile are added to the consumption for each passenger-car of twenty tons or more moved at way-train speed, and for each sleeping-car of thirty tons or more moved in through trains making few stops, and that the locomotive alone is to be charged with rather more coal than that due to three cars.

— The discovery of an interesting illusory effect in the sense of sight is given by Professor Exner

in the *Biologisches centralblatt.* His attention was directed to the subject by a simple incident. Lying upon the floor of a hut near an open fire, he noticed that the sky, as seen through a small window, seemed frequently lit up, as though by lightning. Assuring himself that such was not the case, he found that the apparent phenomenon was due to a deception caused by the flickering light in the room, though no changes in its intensity were visible. To show the effect more strongly, he constructed a translucent shade before a lamp, upon which he attached a small disk of thick white paper. This lamp was so arranged that its brightness might be quickly and easily varied. On the other side a gas-lamp enclosed by an opaque cylinder was placed, emitting a ray of light through a lens directly upon the paper disk. Looking now at the disk through a hollow cylinder at a distance of several feet, while the light behind the shade was made to vary in intensity, there was found a striking effect, in that the variation appeared to rest only in the paper disk, while the surrounding field appeared constant. This illusion, the author says, shows that we are inclined to hold as constant the predominating brightness in the field of vision, and attribute variation to the subordinate.

— It has been experimentally proved by the English commission on accidents in mines, as stated in their last report. that a percentage of marsh-gas amounting to five per cent, or even four per cent, of atmospheric air, is decidedly explosive. Half of this proportion, however, though not in itself dangerous, and though impossible of detection by ordinary lamp-tests, will explode if the air be laden even lightly with fine, dry coal-dust ; and it is probable that some of the obscure causes of accidents may be ascribed to this cause. The opinion of the commissioners with regard to the older Davy, Clauny, or even Stephenson lamps, is that they have in a great measure lost their value in consequence of the draughts of air from the free ventilation. A current of air of eight hundred feet per minute in an impure atmosphere may, in spite of the wire gauze, effect an explosion in any one of them. Electric lighting is already to some extent in use ; and as the risk from its use is much less, and its lighting-power greater, it probably will be more generally adopted.

— The summary report of the operations of the geological and natural history survey of the Dominion of Canada by the director, A. R. C. Selwyn, gives a creditable showing for the amount of money expended. Work, chiefly geological and topographical, has been prosecuted over portions of every province and territory in the dominion, from Nova Scotia to the west coast of Vancouver Island. The *personnel* of the survey is now composed of a staff of fifty employees, — thirty-four professional, and sixteen ordinary. The expenditure amounted to something over ninety thousand dollars during the past year. The topographical results will be embodied in a number of maps now in process of preparation. These maps include one of British Columbia, that will shortly be published ; one of Assiniboia, now in the hands of the engraver ; and one of the Bow and Saskatchewan rivers, on a scale of eight miles to the inch, well advanced. Another on Manitoba and western Ontario, to cover 3,456 square miles, and a very important geological map of the peninsular portion of Ontario, to be issued in sheets of uniform size, are in progress, as well as maps of Quebec, the Lake of Mistassini and adjacent regions, and portions of Nova Scotia and New Brunswick. Much less attention is paid to biology, with the exception of paleontology ; yet in botany and zoölogy considerable progress has been made. Among the more interesting results of the explorations is the determination of the size of Lake Mistassini, about which there has been great uncertainty. It was found to be about one hundred miles in length, with an average breadth of about twelve miles, — a very different figure from what is represented on the maps.

— Dr. Alfred Goldscheider, says the *Lancet*, has recently published the results of researches he has made upon the nerves, by which sensations of temperature and pressure are conducted. He finds that the skin is not in all parts capable of perceiving variation of temperature, and that some parts can only recognize sensations of cold, other parts only sensations of heat. These, which he terms warm and cold points, are distributed between or among each other, but never coincide. Their general arrangement is, that they are disposed in chains which pursue a slightly curved course. These chains radiate from certain points, which may be termed radiation-points or temperature-centres. The chains of the cold-points do not in general coincide with those of the heat-points, but these radiation-points are identical. The cold-points are in all parts of the skin more numerous than the warm-points. When the cold-points are excited by either mechanical or electrical stimuli, a punctiform sensation of cold is experienced, and the opposite sensation is felt when the warm-points are stimulated. Goldscheider was able, by stimulation of nerve-trunks, to excite eccentric sensations of heat and cold. The temperature-points were found to be insensitive

to pricks and other punctiform pain-excitants. Goldscheider admits, therefore, not only the existence of nerves exclusively devoted to perceptions of temperature, but specific nerves for heat and cold. The sensibility of the surface of the body to temperature presents great topical variations, and is directly dependent in any region upon the number and intensity of the temperature-points, — that is to say, upon the local wealth of temperature-nerves, — and go hand in hand with the distribution of the great nerve-trunks. Goldscheider also differentiates in the skin nerves of general sensation and specific pressure-nerves. The latter terminate in certain points of the skin which are not only especially sensitive to very delicate contact, but contain also peculiar organs which excite a granular sensation on pressure. The pressure-points are arranged after the same fashion as the temperature-points, but are in general much more closely aggregated. Both they and the temperature-points supply us with information in regard to locality.

— Any one may become a member of the Roman alphabet association, to which reference is made in the article in this number on 'The intellectual movement in Japan,' by the payment of an annual fee of one dollar. All donations should be addressed to Roma-ji-kai, Tokio, Japan.

— The dredging-machinery for the excavation of the Panama canal is exceedingly powerful. One of the dredges excavates 3,300 cubic metres per day, and there are two others which excavate 800 and 1,000 cubic metres. Besides these, there are a number of smaller ones in operation, in all, capable of excavating 37,000 cubic metres per day. It is reported that during the month of February, upwards of 1,100,000 cubic metres were excavated.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On a geodetic survey of the United States.

I HAVE been often asked why a geodetic survey and triangulation is the only mode of surveying a large area with precision, and why such slow and tedious methods are requisite for needful accuracy. This paper is an attempt to show, in popular language, both the processes themselves and their necessity; as also why congress should act upon the repeated recommendations of the national academy, and carry out its views.

To many of the habitual readers of *Science*, this letter will appear to deal with elementary matters which they may be assumed to know. To another large and equally earnest class of readers, it may convey useful information. Possibly it may help forward the end sought for; and to this every true lover of science will cry 'God speed.'

Any survey of a small area, as a farm, plantation, or township, may be made by any of the usual methods adopted in ordinary land-surveying, where the area covered by the survey is treated as a plane surface.

The compass and Gunter's chain of sixty-six feet are the usual surveying-instruments in this country. They are liable to serious error. Lack of knowledge of the true local magnetic variation of its secular change from year to year, and of its diurnal change between morning and afternoon, with the always impending possibilities of special local attraction at or near the place surveyed, are among the difficulties attending the use of the compass. The chain stretches with use, and changes its length with the seasons and their varying temperatures, and is often carelessly carried by men little accustomed to precise methods. It is not too much to say that any land worth fifty dollars an acre is too valuable to be surveyed with a compass, and any record of such a survey is likely to become a fruitful source of future litigation. The best of such surveys are but approximations to the truth.

Errors from these approximate measurements are cumulative. When such surveys are extended over large areas, as upon our public lands, serious consequences follow, involving present and future doubt and litigation as to boundaries. This is already apparent in the west. It will become more so in the future as land increases in value.

The necessity for greater precision in original public-land surveys, and for means of ascertaining and checking errors already existing, has been forcibly stated in a report to congress on the survey of the territories, by the National academy of sciences in November, 1878, printed in 'Misc. doc. No. 5, house of representatives, 45th congress, 3d session.' The report of the academy, and the very strong letter of Major J. W. Powell, which forms a part of it, fully describe the character and consequences of the errors alluded to. It also sets forth the true remedy as only to be found in a method of survey which should be as nearly infallible as scientific skill and a laborious and careful application of well-known principles could make it.

This method, as practised for two centuries by civilized nations, consists of a system of triangles, starting from and proceeding toward certain base-lines, measured with every possible care with apparatus specially devised to either entirely eliminate, or to reduce to a minimum, every source of error, whether physical or mechanical, which might vitiate the resulting length of the measured line, or cast a doubt upon its precision.

Apparatus of this nature is now constructed and used, in the U. S. coast and geodetic survey, of such precision that the average probable error of the two primary bases last measured with different apparatus, constructed on different principles, is, roughly, about one twelve-hundred-thousandth part of the lengths of the measured lines.

The exact length of the base being ascertained, and a system of triangles built upon it adapted to and covering the country to be surveyed, the lengths of all the other sides of the triangles in the system are inferred from the familiar theorem that "every triangle has six elements or functions, — viz., three sides and three angles, — any three of which being known (one being a side), the other unknown elements may be computed" with a degree of precision of the same order as that of the known elements.

It is therefore only necessary to measure the angles with the same precision as the base, to insure equally precise results. This is so far attainable, that the latest great primary triangulation of the coast and geodetic survey, enclosed between two measured bases six hundred miles apart, met nearly midway, at a line about twenty-nine miles and a half long. The computed lengths of the line, from measured bases distant about three hundred miles from either of them, agreed within about five-eighths of an inch.

It follows from the above, that, in any system of triangulation carefully conducted, the relation of every point in the system to every other point may be determined with a degree of precision almost absolute. It renders the position of each apex of a triangle infallible ; since its error, if any, can only be detected by application of similar methods of precision, which will themselves be liable to the same sources of error.

Referring to what has been written as to cumulative errors belonging to all ordinary local topographical or other surveys, it is evident, that, if these surveys include two or more trigonometrical points within their limits, the inevitable error involved in their methods is checked and corrected as each such point is successively reached. If it is not exactly hit, the local survey is wrong, and must be corrected to meet the triangulation-point, which stands as infallible in its assigned position as the pope claims to be in his.

The triangulation gives the relation of every point in the system to every other point. To apply the data thus obtained to its chief use in the construction of accurate maps, from the local surveys thus checked and corrected, another class of observations and reductions becomes necessary to fit the framework which has been constructed to its proper place upon the surface of the earth. This, with the triangulation, constitutes what may properly be called geodesy. No better definition of this term can be given than that by the late Gen. R. D. Cutts : "Geodesy, in practice, may be described as a system of the most exact land-measurements, extended in the form of a triangulation over a large area ; controlled, in its relation to the meridian, by astronomical azimuths ; computed by formulae based on the dimensions of the [adopted] spheroid ; and placed in its true position on the surface of the earth by astronomical latitudes and differences of longitude from an established meridian."

The whole system of triangulation thus combined and co-ordinated, and made to occupy its true position upon the earth's surface, may be compared to a human skeleton. As the skeleton is the framework on which is built and sustained the varied elements of the human body, each fitted to and held in its place by the unyielding structure sustaining it, so the triangulation is the framework on which each varied portion of the earth's surface within its range is also fitted to and held in its true position, and the resulting map becomes an absolutely true topographical picture of the country it purports to represent.

But this is only one, and not the greatest, good represented by a well-executed and complete geodetic survey. Every point of the triangulation is carefully marked above and beneath the surface for reference in future ages. Every recorded distance between any two points thus marked becomes a base-line, whose length is known with a degree of precision unattainable by ordinary methods. So, also, is the azimuth or angle with the true meridian made by every such line, thus affording means for ascertaining the local magnetic variation and its yearly change. The recorded and published latitude and longitude of any station will enable future astronomers to find close at hand the means of fixing their precise relations to other and distant observatories. As the country increases in population and wealth, its topographical features change. New towns are built, and new roads and new railroads laid out. New maps will be called for, and easily supplied, since the framework of the triangulation, executed half a century before, perhaps, is there, always correct and reliable. As the elevations of all the stations above the mean level of the sea have been determined in the original survey, so, if schemes of drainage are planned to bring swamp-lands into use for arable purposes, these differences of level will afford data for obtaining the amount of fall and its proper direction. And so long as the earth and sea maintain their relative positions, so long the beneficent effect of early and exact triangulation will continue to be felt.

This is essentially a national work. It cannot be defined by, or confined within, state boundaries. Whatever views may be held as to local topographical surveys, and who shall execute them, it is evident that the framework on which they are to be built must be independent of political boundaries. The triangle sides leap across bays and lakes, or from mountain to mountain and hill to hill, or they travel 'upon stilts' across the level swamps and prairies. Nature only fixes its limits. It is homogeneous and universal by its own conditions of existence. The geodetic survey of all our country is therefore a work eminently proper for the national government to carry on, leaving the other questions of local topographical surveys for national or state action, or for both combined, as in Massachusetts.

The National academy of sciences, which is, by law, the adviser of congress and the executive upon scientific matters, has twice, at the call of congress, advised the early execution of this great work, and that its execution should be intrusted to the coast and geodetic survey as best fitted, in men, means, and training, to carry it on. Lately the need of prompt action in the same direction has been well and strongly set forth by Prof. W. P. Trowbridge of Columbia college, whose large experience gives weight to his words.

If states whose interests require good maps will join with commercial bodies and scientific men in urging legislation, the plan proposed by the national academy in 1878, and again in 1884, may be carried out with no duplication of other work, but, on the contrary, with cordial and complete co-ordination with other surveys. The whole country would be benefited thereby to an amount far exceeding the outlay. C. O. BOUTELLE.

Washington, May 11.

Double vision.

Your correspondent, Dr. George Keller, will find the phenomena of double vision discussed in Helmholtz's 'Physiological optics,' and in LeConte's book on sight. The latter is a small volume published by D. Appleton & Co., New York. The production of binocular images, apparently suspended in mid-air, on regarding a tessellated pavement or papered wall

with visual lines appropriately crossed, is discussed but incorrectly explained by Sir David Brewster in his book on the stereoscope, many of his experiments having been performed more than forty years ago.

Dr. Keller seems to be affected slightly with divergent strabismus; which, however, has not resulted, as it so often does, in the loss of power to secure binocular vision. He will find the phenomena of vision by optic divergence discussed in a series of articles entitled 'Notes on physiological optics,' published in the *American journal of science* for November and December, 1881, March, April, May, October, and November, 1882.

W. LECONTE STEVENS.

170 Joralemon Street, Brooklyn, May 15.

Diathermancy of ebonite.

Absence from home has prevented me seeing sooner *Science* for April 30.

In referring to my paper read before the April meeting of the National academy of sciences, you state, "Prof. Alfred M. Mayer, in describing recent work, stated that he had succeeded, by the use of a lens of ebonite, in inflaming various substances by the concentration of dark rays, for which ebonite is translucent." The statement is not what I stated before the academy. The title of my paper, as published by the academy, is, "On the diathermancy of ebonite and obsidian, and on the production of calorescence by means of screens of ebonite and obsidian."

The focus of dark rays was obtained by 'screens' of ebonite and of obsidian placed across the cone of rays reflected from a large mirror, or those refracted by a lens of glass of twenty inches diameter. I have obtained foci of dark rays with a combination of thin lenses of ebonite, but the heat of such foci is not sufficient to inflame substances.

ALFRED M. MAYER.

Hoboken, N.J., May 13.

Pharyngeal respiratory movements of adult amphibia under water.

The letter of Profs. S. H. and S. P. Gage, in your issue of April 30, induces me to recall and publish an observation made by me in 1877.

During a stay of some months in New York in the summer of that year, I several times visited a museum and aquarium, situated, if I remember aright, on 6th Avenue. I saw there a very fine specimen of Cryptobranchus Alleghaniensis about twenty inches long. I watched from time to time for several hours, but never saw it rise to the surface for air. As it lay at the bottom of its clear glass tank, I saw very distinctly continuous rhythmical respiratory movements. These, however, were not confined to the pharyngeal region, but seemed to me to extend the whole length of the body-cavity. It was a kind of squirming or wriggling movement running down the body. I looked carefully for currents issuing from gill-slits, but could see none.

At that time I concluded that the movements served the purpose of churning up the air in the lungs so as to utilize as much of the oxygen as possible. This seemed the more necessary in amphibians on account of the simplicity of their lung-sac. I had fully intended to draw scientific attention to the subject, but on returning home I could not at once lay my hand on a good account of the gill apparatus of the adult Cryptobranchus, and meanwhile other things engaged and diverted my attention.

It might be well for those who are studying this subject to at least bear in mind the suggestion that rhythmic movements may possibly serve to utilize more perfectly the oxygen contained in the lungs of animals capable of remaining long under water. In my boyhood I have often waited, rifle in hand, three hours for an alligator to rise; and that, too, in mid-summer, when their vitality is highest.

JOSEPH LECONTE.

Berkeley, Cal., May 10.

Absorption of mercurial vapor by soils.

In the issue of *Science* for April 23, it is stated (p. 370) that the mercurial-vapor remedy has, in the hands of myself and assistant, failed to produce its promised results as a phylloxera insecticide.

This sweeping statement is not justified by the facts given by me in the issue of this journal for Dec. 4, 1885, and by its further elaboration as given in the 'Report on viticultural work,' since published. It has been demonstrated by our experiments that the reported total failures were due to improper materials used in the preparation of the mercurial mixtures, whereby the formation of mercurial vapor in the soil was practically prevented, and that when reasonably pure mercury is employed, and proper means used for its distribution in the soil, all insects within the mercurialized area died in the course of from thirty to forty-eight hours at the ordinary temperature, and much more rapidly at a higher one. It therefore appears perfectly practicable to protect vines planted in uninfested ground from attack coming from without, by surrounding the stocks with a sufficiently thick (eight to ten inch) layer of mercurialized soil, which, without obstructing or repelling the entering insects, will insure their being fatally poisoned before they can pass through it. This would leave the choice between grafting on resistant stocks on the one hand, and the mercurial protection on the other, in the planting of new vineyards, the cost being (in California) about the same in either case; it would also serve for protection against threatened invasion, in the case of vineyards already planted, since, apart from the case of open soil-cracks giving access to the vine-roots, the stocks are the only known route by which the phylloxera reaches the root. Such are the presumptions created by our small-scale experiments: how far the process will prove available in large-scale practice, remains to be determined by experience, but there is no especial reason to question its feasibility.

As regards, however, the treatment of ground and vines already infested, our experiments tend to show that the diffusion of the mercurial vapor is too slow, at the ordinary soil-temperatures, to promise success; especially in the case of clay soils, which absorb and render inert a large amount of mercurial vapor before an effective excess can be obtained.

It has been abundantly shown that the mercurialized soil exerts no unfavorable action upon the growth of the vine; and there is every reason to expect that an application once made will remain effective during the life of the vine.

E. W. HILGARD.

Berkeley, Cal., April 8.

SCIENCE.—SUPPLEMENT.

FRIDAY, MAY 21, 1886.

THE AGRICULTURAL INDUSTRIES OF JAPAN.

It was not many years ago that Japan was looked upon as an uncivilized nation, and her remarkable development during the past two decades has been a subject of astonishment to the civilized world. It speaks well for the natural intelligence of her people that she has profited so well by the experiences of foreign civilization, and much can be expected in her future progress. Many conditions productive of evil in civilization have not yet found a place in her affairs, and in some respects the lower classes may be considered as occupying a higher plane than those of more favored European countries.

A recent paper[1] by Prof. M. Fesca, with the assistance of Mr. N. Tsuneto, presents one of the fullest accounts of the agricultural conditions and industries of this people that have so far appeared, from which we give an abstract of the more interesting portions.

Many important factors affecting the agriculture of Japan, as would naturally be supposed, have yet received comparatively little attention, although the results so far attained are surprising when we take into consideration the rapidity with which they have been produced. Especially is there need of a more scientific study of the climate and meteorological conditions. Most of the meteorological stations hitherto founded are along the seacoast, with but very few in the interior.

One of the chief hinderances to the development of Japanese agriculture has been the burdensome system of taxation, which is levied almost exclusively upon real estate, and which prevents the use of capital to any great extent. The high rate of interest, of which fifteen per cent is considered moderate, for money loaned upon real estate, almost prohibits its use. In those districts where agriculture has reached its chief development, it has been due almost wholly to unaided manual labor.

Agriculture can only reach its highest development when the producer owns the land, and especially when capital is unrestricted in its employment for its improvement or cultivation. Statistics, so far as they are available, however, show that lease systems, wherein compensation is derived either by division of crops or from money payments, predominate over independent tenures of land in Japan. In the dryer lands money-rent is usually paid, varying in amounts for the different crops raised. For rice-land the so-called 'half-crop' system is the more common one, though in reality a far larger proportion of the gross harvest returns is paid. Four-fifths of the crop go to the owner of the land; and, from the one-fifth remaining, all the costs of fertilizing and harvesting must be obtained, and which not seldom consume its substance. The remedy for these evils will only be found in the legal control of the lease systems, and more especially by a change in the system of taxation, which will relieve the land from the severe burdens now imposed upon it, and thus bring about more favorable systems of credit, admitting of the more extensive use of capital. At present the lessee of small farms derives only a very meagre income.

Another important factor which exerts a most depressing influence upon Japanese agriculture, is the difficulty and cost of transportation. The lack of water-ways, railways, and good roads in Japan is very sensibly felt. The pack-horse is the means upon which the chief reliance is placed for carrying; and upon the best roads the burden of three hundred and thirty pounds costs ten sen[1] per ri, while upon bad roads the cost may be quadrupled. This high cost of transportation influences in a very great degree the sale of farm produce. Rice commands the highest price among the grains, in Tokio the past year selling for one dollar per hundredweight. The cost of its transportation for twenty miles amounts to as much as its price. When this is compared with the cost of the transportation of wheat by railroads in America, some appreciation of the immense disadvantage under which Japan labors will be apparent. For this reason the regions of the coast are far more preferred for agriculture than the inland, every possible portion being utilized, while in the interior often large tracts of good land are left untilled.

Thus it will be seen that one of the chief demands of Japan is for better and cheaper means

[1] *Die landwirthschaftlichen verhältnisse der Kai-provinz in beziehung zu denen des japanischen reichs, Mittheilungen der agronomischen abtheilung der kaiserlich japanischen geologischen reichsanstalt*, April, 1886.

[1] 100 sen = 1 yen, about 86 cents; 1.9 ri = 1 geographical mile. The Japanese terms are mostly reduced to their English equivalents.

of transportation. Railroads, so far, have done little towards remedying the evil, and will not unless tariffs are sufficiently lessened to admit of more extended commerce. The distance between Tokio and Kofu is about sixty-four miles, one half of which is easily, the other with difficulty, passable. The cost of transportation by horses is nine yen per load (over two dollars per hundred-weight). The following market-prices at Tokio, of a few of the more important productions, will show the extent to which the cost of transportation affects the price : —

	Per cwt.	Cost of transportation from Kofu.
Tobacco (medium quality)	$15.50	15.5%
Cotton (medium quality)	13.00	10.0%
Cotton (raw)	5.20	25.3%
Silk-worm cocoons	66.00	1.9%
Silk-stuffs	333.00	0.5%

The great cost of transportation of raw or bulky articles has caused certain industries, as silk culture and weaving, where the manufactured material is of light weight and easily transportable, to be extensively prosecuted in the interior, especially by the women, and such industries are thus properly classed as agricultural.

Japanese statistics of agricultural productions are necessarily imperfect, but they are sufficient to afford a tolerably good idea of the resources of the kingdom, or at least of some portions of it. The area of the entire kingdom, as at present constituted, comprises 24,294 square ri (87,701 square miles), or 11,054,019 cho (27,082,346 acres). The following table will show the proportions of tilled, tillable, and other lands, together with the prices for the same : —

	Acres.	Per cent of entire land.	Average price per acre.
Rice-land	6,605,627	23.80	$194.00
Other tilled land	4,631,137	16.80	57.30
Forest-land	13,601,427	49.35	1.36
Tillable (uncultivated land)	1,890,150	6.85	1.00
Building-ground (villages and cities)	871,350	—	500.00
Salt-yards	15,910	—	120.00

The unoccupied tillable lands are covered with scant vegetation, which serves for pasturage for stock, though little used : doubtless the figures given are too small, and should be increased at the expense of those for forest-land. The salt fields or yards (*salzgärten*) are the only sources of salt in Japan, and are for the evaporation of sea-water. Rock-salt and salt-wells have not, so far, been discovered in the kingdom. Salt, it may be mentioned, furnishes a good example of the variation in the cost of transportation, as in some parts it commands nearly thirty times what it does in others. The rice-land, it will be seen, comprises nearly one-fourth of the entire superficial area, and commands more than three times the price of other tilled land.

The price of really valuable land can in no wise be considered as low, as compared with that of the agricultural lands in Germany. The price of rice-land is at least one-half greater, and, of the other grain-lands, about half as great.

The number of those engaged in agricultural industries throughout the kingdom, from the returns that are available, is as follows : males, 8,237,682 ; females, 7,398,431 ; total, 15,636,113. The entire population of the kingdom was nearly thirty-seven million ; and for such a distinctively agricultural nation as Japan, the proportion devoted to agriculture appears small. This disproportion may in part be attributed to the great number of officials, and petty shops and pedlers, — occupations which draw from the lower classes, by reason of the less labor required, and the comparatively less onerous taxation imposed upon them, than is the case in the agricultural pursuits ; and in part to the fact that those partially engaged in other pursuits are often not counted as agriculturalists. There are only about three-fifths of an acre of tilled land to each individual in the entire population, or less than three acres to the average family.

It will not be without interest to make some mention of the foods used by the people. The Japanese are almost exclusively vegetarians, — a fact that is to be deplored, from the detrimental influence it has upon the raising of live-stock. On the coast, fish and other sea-foods are used in considerable quantities ; but at a distance, from the ever-recurring element of transportation cost, these foods form only an immaterial proportion of the alimentation. Rice is the chief comestible, except in such higher regions where it cannot be raised, and where the cost of importation virtually prohibits its use. The percentages of the different foods consumed are as follows : —

Rice	53.00
Barley and wheat	27.00
Millet and other grain	13 90
Sweet-potatoes and garden-vegetables	6 00
Fruit	0.05
Algae	0.05

Farm-laborers are paid throughout the kingdom, on an average, in summer, 18 cents per day for the best men, and 13.3 for the best women ; for a poorer class of men the compensation is

12.5 cents, and of women 8 cents: in winter they are paid 14.5 and 9.1, and 9.8 and 5.5 cents respectively. This is in addition to board. The highest price paid in any province is, in summer, 27 cents for men, and 20 cents for women. The average price per year is $30.50; the maximum, $74; the minimum, $13.70; in Tokio, $31.40. Taking all things into consideration, in comparison with the sums paid for similar labor in Germany, farm-labor is decidedly dearer in Japan.

These high wages may be taken as an expression of a more uniform distribution of property than obtains in the European countries, and speak in favor, rather than against, the social conditions of the kingdom. There does not prevail that sharp contrast between luxurious wealth and hungering misery; and as a result, class hatreds, with all their attendant evils, are foreign to Japan. Wages, however, are much higher at present than they were even a few years ago. In some provinces during the last twenty years they have increased seven or eight fold.

It will be of interest to give the actual production of the staple products of the kingdom for 1882, as nearly as can be obtained from statistics.

	Entire production.	Per acre.
Rice (meadow and upland)	162,269,090 bush.	25.25 bush.
Barley	53,933,050 "	22.50 "
Wheat	12,782,380 "	14.1 "
Beans	11,927,819 "	11.9 "
Millet	14,981,874 "	—
Sorghum	367,784 "	—
Buckwheat	3,458,639 "	9.5 "
Potatoes	74,117,611 lbs.	3,700.00 lbs.
Sweet-potatoes	2,150,975,313 "	6,250 00 "

It is necessary to observe, in explanation of these figures (a calculation of which will show an apparently greater number of acres than are actually under cultivation), that in many cases two or even more crops are obtained annually from the same field.

The entire value of these crops reached, according to the statistics of 1882, the sum of 158,884,113 yen ($123,462,655). This gives a gross sum of $12.44 per acre, and less than $8 for each individual engaged in agricultural pursuits. In comparing these figures with those of the averages of the eight older Prussian provinces, between the years 1859 and 1864 they are found to be more than one-third less. The net results, however, of the returns, per capita, are considerably less; scarcely, in favorable cases, reaching $3.50. They do not, however, indicate the true condition of affairs. A laboring man requires for annual consumption, about five bushels of rice, and the average for man and woman may be placed at four bushels. As the cost of this quantity is over four dollars (4.5 yen per koku=1.8 hectolitres), the people would be reduced to a much cheaper way of living, which is not the case. The exports and imports are comparatively trivial, and will nearly balance each other.

More than one-eighth of all the rice grown is consumed in the production of *sake*, the alcoholic drink universally used in Japan, leaving, on an average, about 3.5 bushels as the annual amount per capita. Adding to rice other productions, it is found that 5.7 bushels of grain represent the quantity annually consumed by each individual of the population, to which should also be added about 60 pounds of potatoes.

During the twelve years between 1868 and 1879 the entire export of rice amounted to a little over seven million bushels, with the imports a little more than twice that quantity. Of the other produce, figures cannot be given. It will thus be seen that the annual production of food-stuffs suffices for the entire population, although it is true the quota is by no means equally distributed throughout the population. The better-situated half takes the lion's share, to the deprivation of the lower class.

Statistics of the cultivation of rice sufficiently trustworthy to entitle them to our acceptance, reach back for nearly a thousand years, and show that there has been a steady decrease in the yield per acre. Thus in the period between 923 and 930 the area devoted to its culture amounted to 2,558,390 acres, with a yield of 95,924,326 bushels; while in 1868, with an area of 6,559,192 acres, the yield was only 157,153,500 bushels. Thus, while the entire area devoted to the crop has doubled, the crop itself has only increased about one-half. Undoubtedly a part of this is due to the added lands being less adapted to rice-cultivation.

The agriculture of Japan has progressed in its peculiar way without reference to stock-raising. For a very long period religious prejudices have not favored the use of flesh as a food, although it has not been strictly forbidden. There has been no demand for this food, and domestic animals were looked upon only as beasts of burden and sources of fertilizing-material. This exclusion of stock-raising has markedly influenced the extension of strictly agricultural industries. In the vicinity of the coasts the smallest portions of suitable land are cultivated, while at a distance the extent of untilled land becomes much greater. In thickly populated regions fertilizing-material, especially that from human sources, — the chief ones in Japan, — exists in much greater abundance, as also such material as fish-guano, seaweed, etc., furnished by the sea; but these cannot be made use of at any distance from the coast, for, under

the existing unfavorable conditions, they do not admit of being transported. In the regions remote from the coast and the more thickly settled districts, various substances, such as wood-ashes, the residue from grapes, cottonseed, beans, etc., are used for fertilizing-material; but the extent to which they can be employed is very limited, and for this reason some better source of compost-material is highly desirable for the further development of inland agriculture. The necessity of the introduction of stock-raising has been recognized in Japan, although its true value has hitherto not been rightly appreciated.

About eighteen years ago, Japan suddenly exchanged its mediaeval condition for one very different; and this must be taken into consideration in judging of the present state of affairs in that country, since, under such circumstances, one cannot wonder that errors have been committed, but, rather, that the results already reached have been so remarkable. Already a network of telegraph-wires covers the entire land, and railroads are increasing from year to year; and in the laws of the country undoubted improvements have been brought about. In the civilized countries of Europe the development of the modern condition from the mediaeval one was gradual; but in Japan this development has been not only more rapid, but also in many respects peculiar. Not only has it made use of many counsellors and teachers from other countries, but it has sent out a very considerable number of its own students to other lands, who have brought back many of the modern inventions and discoveries of civilized life. Such a process of development has been in many respects of great advantage to Japan, although not wholly without its elements of danger. They can avail themselves of the multitudinous results of civilization which have been slowly and laboriously acquired in European states in the many centuries, and at the same time avoid the many errors taught by painful experience, though it must be borne in mind that the old mediaeval conditions are not yet entirely done away with.

These conditions must be taken into account in treating of the development of live-stock industries in Japan. In the civilized nations of Europe, it is well known, that, until recently, live-stock was looked upon as a necessary evil, useful only as machines for the production of fertilizing-material. Circumstances were deemed fortunate when the income derived from the stock was sufficient to pay expenses, and thus furnish manure free of cost. In England scarcely a hundred years have elapsed since stock-raising has attained an independent position as a profitable industry, and in Germany its importance was not appreciated till a much later period. While in many other agricultural and technical matters Japan's progress has been more rapid than was the case in Europe, the difficulties which stock-raising encounter are greater, rather than less, than were the European ones in past centuries.

In the live-stock industries of Japan the horse and the ox are the only animals which have attained any degree of importance. Sheep do not thrive in the moist climate, and attempts have shown the uselessness of endeavoring to introduce this branch of stock-raising. But little attention is paid to hog-raising, although circumstances would seem to indicate its profitableness, and the opportuneness of its inception on a more extended scale.

The number of cattle in Japan is not only absolutely, but also relatively in proportion to the population, very small. In 1879 there were but 4.1 horses and 2.9 oxen or cows to every hundred inhabitants, — a number, for the latter, remarkably small. In the same year there was less than one head of cattle slaughtered for every thousand inhabitants for food, the consumption varying in the different provinces from five and a half per thousand to less than one per hundred thousand. Even in the large province of Musashi, in which the large flesh-consuming cities of Tokio and Yokohama lie, the consumption amounted to only 3.1 per thousand inhabitants.

It has been often asserted that the consumption of flesh in Japan is steadily increasing. Of the 1,075,520 head of cattle in Japan in 1877, 33,959 were slaughtered; in 1882 there were 1,159,750, of which 36,288 were slaughtered, — in both cases bearing the same percentage, 3.1, to the entire number. This percentage is very small, and it is seen that a large proportion of the stock must live to be very old, and die natural deaths.

Milk and butter, as will be understood, are unsalable in the interior, and non-transportable, and cheese and condensed-milk manufacturing requires more capital than is disposable in Japan. Further, the entire population has for butter and cheese a decided dislike, which is not wholly overcome even by those who have become accustomed to European diet.

Attempts have been made to improve the industry by the importation of foreign cattle; but this has been done without a proper study of the adaptability of different breeds to the peculiar climate and mountainous topography of the country, and the result has not been wholly satisfactory. Instead of introducing stock from the highlands of Scotland, Wales, or, better, from the mountain valleys of South Germany and Switzerland, Shorthorn, Devon, and Hereford stock has been im-

ported. There were imported, largely from America, in 1877, 498 head; in 1882, 1,430. Another obstacle which stock-raising must encounter is the difficulty in the way of pasturage. The scant herbage is unfitted for blooded stock, and the raising of grasses or grain will be unprofitable. In the inland regions the farmers of small means often keep a horse or a cow, not for work, but solely for the manure derived from it. It shows strikingly the lack of capital everywhere so prevalent. When a farmer finds an ox or a cow too costly, he buys a superannuated or broken-down pack-horse that can hardly stand, feeds it, and carefully collects the manure.

Notwithstanding all the obstacles, the importation and improvement of cattle in Japan, the author believes, should certainly not be abandoned. By a proper study of natural conditions, stock-raising may do much toward bettering the circumstances of the Japanese people.

A BOOK-MANUFACTORY IN ANCIENT ROME.

IN the *Illustrirtes schweizerisches unterhaltungsblatt für stenographen*, the *Publishers' weekly* finds an interesting account of the production of books in ancient Rome. It is stated therein, that, notwithstanding the Romans had no printing-presses, books were at that time produced much more quickly and in larger numbers than most modern works. Paper was used which was almost woven out of the fibre of the Egyptian papyrus, which grows to a height of ten feet, and which has given its name to paper. A Roman residing in Egypt assures us that the yield of his paper-manufactory would be sufficient to support an army, and whole shiploads of paper were sent from Egypt to Rome. Before books of any description were reproduced in large numbers, they were read mostly either in private circles or publicly, so that the author could adopt suggestions for the improvement of his work. Wealthy Romans used to own a large number of slaves for all kinds of services, which rendered labor cheap, as they cost nothing in many cases, and had only to be supported. They were mostly prisoners of war, the pick of nations, and often more cultivated (especially the Greeks) than their masters. They were consequently also employed in the education of Roman boys. The works of authors were dictated to a number of slaves, women also being employed for that purpose. Even among freemen and liberated slaves the desire to obtain employment became so great, that hundreds of willing hands could be had for writing books at a very low rate of wages. The instruction imparted in the workshops of Roman publishers necessitated a regular course of training, which was to teach the apprentices an easy and elegant handwriting. If a publisher had at his disposal, say, a hundred writers, and reckoning the working-day at ten hours, a document which took an hour to write would be multiplied in the course of a day to a thousand copies. The writers became in time expert to such a degree that they combined quickness with elegance. It must also be added that in cases where speed was the first consideration, the use of stenographic contractions became general, and we possess illustrations of their employment in the old manuscripts still in existence. We are also informed that both readers and copyists were instructed and trained, the former in the solution, the latter in the application, of contractions. Their object was to copy works as quickly as possible, the use of full words being only resorted to for the best works. The above brief account demonstrates the fact that the Romans made the nearest approach to the invention of printing, although they never attained to it. The movable stamps of iron or other metals used by the Romans for marking earthenware vessels or other utensils also prove this. But the art of rapid writing, which was perfected by them to an unusual degree, counteracted a further development, while the number of slaves and other willing hands at disposal, by which means the most astonishing results were obtained, operated in the same direction.

THE HEATING-POWER OF GAS.

THE introduction of the gas-engine and the increased use of ordinary illuminating-gas for domestic heating-purposes, renders its calorific properties of far more importance than they were a few years ago, says *Engineering*. The experiments made on this subject do not appear to have been very exhaustive, and, if we may judge by those we are about to quote, have not always been carried out with due care. M. Aimé Witz, whose researches in connection with the gas-engine are well known, has lately made some experiments in order to determine with greater accuracy the heating-power in ordinary French illuminating-gas. His apparatus was composed of an explosion-cylinder of nickel-plated steel 2.36 inches internal diameter and 3.54 inches high. The thickness of the metal was .079 of an inch. The top and bottom covers were tightly screwed on, rendering the chamber air-tight. Through the top cover a wire passed, and on the bottom was a valve for filling or emptying the receptacle. This cylinder was contained in a vessel 4 inches in diameter and

8 inches high. This acted as a calorimeter, the amount of water required to charge it being 1.76 pints. In order to charge the explosion-cylinder, it is first filled with mercury, which is allowed to run out, the explosive mixture of air and gas taking its place. The explosion was caused by an electric current passing through the wire in the top cover. The result of a large number of experiments led to the conclusion that the average calorific power of well-purified illuminating-gas, as generally stipulated for by the concessions of French gas companies, is about 5,200 calories per cubic metre. This is equal to 584 British units per cubic foot. The standard of 6,000 calories, hitherto generally accepted, would therefore be too high. M. Witz's experiments more nearly accord with those recently made by Mr. Dugald Clerk, who estimated 504,888 and 489,268 foot-pounds per cubic foot as the mechanical equivalents of Manchester and London gas. This would correspond to 5,640 and 5,372 calories per cubic metre. M. Witz found that the calorific power of gas supplied from the same works varied considerably, at different seasons of the year ranging between 4,719 and 5,425 calories; but the average of tests showed that the difference between the gas supplied by various works was not great. The purification of the gas reduces the calorific power by more than 5 per cent. The gas produced during the last hour of a charge is inferior in heating-power to that obtained during the first hour. The heating-power of gas may be increased 77 per cent by carburation; but the gasoline employed becomes rapidly less volatile, and, when reduced to one-fourth its volume, its enriching-power is only 34 per cent. The details of the experiments, which appear to have been made with every precaution to insure accuracy, have been given in the *Annales de chimie et de physique* for 1885, and are quoted in the abstracts of foreign papers of the Institution of civil engineers.

REMSEN'S INTRODUCTION TO THE STUDY OF CHEMISTRY.

THE difficulty encountered by those who desire to have science which is true science taught in the high schools and academies of this country has been the lack of good teachers and of suitable books. Gradually, however, the books are appearing. Such volumes as those of Gray on botany, Guyot on physical geography, Dana on elementary geology, Martin on physiology, and others which we might name, are excellent examples of the skill with which men of acknowledged distinction as scientific men have prepared text-books adapted to youth in their teens. The influence of such books is to awaken a love of the observation of nature, and to show the scholar how, from simple phenomena, he may proceed to those which are difficult and complex. The improved condition of American school-books is sure to have a lasting effect upon the future citizens of this country. Already the increasing love of scientific studies and pursuits is manifested in a hundred ways.

Professor Remsen has now prepared a chemistry which is intended for those who are beginning the study. No one will question his learning or his experience. For many years his daily round of the laboratory has made him familiar with the perplexities and difficulties which are encountered by students of every grade, — the bright and the dull, the immature and the adult. It sounds paradoxical to hear him declare at the beginning of his work, that, in face of the serious difficulties which lie in the way of a purely scientific treatment of chemistry, he thinks it possible to treat the subject more scientifically than is customary, and thus to make it easier of comprehension.

He therefore lays down as his guiding principle a desire to develop a scientific habit of thought; and this cannot be accomplished either by haphazard, and disconnected experimenting, or by considering the profoundest theories before the student is fitted to comprehend them. The proper course is to begin with an orderly sequence of laboratory lessons, to be performed, if possible, by every pupil for himself, and, if this is not possible, then by the teacher in the presence of a very small class, — not more than ten or a dozen persons.

This volume is therefore prepared as a manual for the laboratory of beginners. The cost of the requisite apparatus is not large, and is quite within the allowances of all superior schools, either for girls or boys. The beginning of the course is very easy; but it soon grows harder, and requires for its conduct a teacher who has himself been trained in laboratory methods. The self-taught chemist will be a very awkward guide. Such an instructor will find his work made delightful by the orderly, progressive steps which are marked out for the class to follow. At frequent intervals questions are interposed which the student himself must answer from his own observation and reading. Enough information is given to make his investigations easy and profitable, not enough to stifle independent thought. The author's doctrine is that a badly performed experiment is as objectionable as a bad recitation or a badly written exercise.

Introduction to the study of chemistry. By IRA REMSEN. New York, *Holt*, 1886. 12°.

By the use of methods like these, chemistry is likely to hold its proper place in an educational curriculum. It should not be play, — a mere mode of whiling away the time in a series of entertaining surprises; and it should not be drudgery, — the attempt to master a series of names and formulas; but the science should be presented to the beginner as it appears to the advanced investigator, as the orderly, prolonged, well-guided study of certain classes of phenomena, in order that the laws which govern them may be discovered and applied.

In the opinion of the writer, which is based upon many years of observation of the study of chemistry as a part of a general education, the volume before us is admirably adapted to the purpose in view. Chemistry thus studied will be found an admirable discipline; and, if the scholar goes no further than to master the pages of this little volume, he will carry with him through life a clear conception of the methods of scientific study, and will thus be saved from many of the perplexities which have beset many scholars whose training has been exclusively based upon books, and who may, unfortunately for themselves and unfortunately often for the world, have been filled with horror at the progress of science. A single year of laboratory work will do more than the mastery of a cyclopaedia to assure the scholar of the truth of modern investigations.

COMPAYRE'S HISTORY OF PEDAGOGY.

To many persons the endeavor to treat teaching and the practice of education generally in a scientific manner seems nonsense. They liken teachers to poets, who must be born, not made, and fall back upon mother wit and natural instinct as the sole requisites for a good teacher. But teaching is not a new occupation: our principals and primary teachers are not the first to impart instruction to children. In fact, teaching is as old as civilization; and it would be strange indeed, if, in all these centuries, no experience that is worth any thing to us had been acquired. Education has been carried on under almost every possible variation of conditions, whether they be geographical, political, social, religious, ethical, or only personal. Human nature has an infinite number of phases, but its essentials vary but little from era to era. Therefore it would be more than strange, it would be miraculous, if the problems that confront our educators to-day had not been more or less dimly perceived and more or less successfully met in the past. Unless a teacher proposes to begin all over again, and try to repeat in his own experience the experience of the race, unless he proposes to test all possible methods, and fall into all the old errors, he certainly ought to be acquainted with the history of his profession. This is placing the desirability of a training in pedagogics on the lowest ground, — that of mere utility. It leaves out of consideration all that great philosophers have said and done concerning education; it takes no account of the relations existing between pedagogics on the one hand, and psychology, ethics, and politics on the other.

For the purpose of giving a general knowledge of past educational theories and practices, we know of no book so useful as the 'Histoire de la pédagogie' of M. Compayré, which Professor Payne has so opportunely translated. Grassberger's volumes are essential to a detailed knowledge of education in Greece and Rome. Schwarz and Niemeyer are excellent so far as they go, Von Raumer is minute on the great German educators, Schmidt's four volumes are classic, and Kloepper's little compend is an excellent manual; but Compayré's book, while not too special and technical to be uninteresting to the general reader, is full enough for the average teacher. We have only one serious fault to find with it, — it is written by a Frenchman. As a consequence of this, the writings of French educators are unduly prominent, and the course of the history of pedagogy is conditioned more or less by the history of France. This is, of course, a patriotic view, but a one-sided one. Since the Renaissance, educational progress has been international; and, if any one nation is to have the place of honor, that nation must be Germany. It is in Germany that the tenets of humanism, realism, philanthropinism and naturalism were most thoroughly developed and put into practice. Sturm was a German; Comenius, Ratich, Lessing, Pestalozzi, Fichte, Herbart, Beneke, Froebel, — to pick names at random, — were all Germans; and Germany, not France (despite the unsurpassed influence of Rousseau), should be most prominent in the history of pedagogy.

Apart from this faulty stand-point, there is little in M. Compayré's history to criticise. It is too brief, perhaps, in its treatment of the great schools of the middle age, but it is correspondingly full on Rousseau. We should be glad to have seen more on the great universities, especially those in Italy and Paris. Rollin, whom the German pedagogues are apt to overlook, receives his proper recognition here. The chapters on the education of women are among the most interesting in the book, and are, if we mistake not,

The history of pedagogy. By Gabriel Compayré. Tr. by W. H. Payne, A.M. Boston, *Heath*, 1886. 12°.

something of an innovation in works of this kind. Professor Payne's analyses of the various chapters are concise and clear, though his criticisms of Herbert Spencer's essay on education seem to leave out of sight the great influence for good that it has worked. The excellent index adds much to the practical value of the book.

Taken altogether, it is a valuable manual, and may safely be recommended to teachers and reading-circles. And for the use of the general public who are not teachers, we know no book at once so complete, and so free from technicalities.

THE STAR-GUIDE.

THIS is described in the preface as an introduction to Webb's 'Celestial objects for common telescopes,' though we should be more inclined to call it a conveniently arranged abstract of that well-known work. The compilers have tabulated in some twenty-four pages, six hundred celestial objects arranged in order of right ascension, comprising nearly every thing that can profitably be examined in our latitude with an instrument of two or three inches aperture (planets are not included). The right ascension and declination of each object is given for Jan. 1, 1886, and the mean time of passing the Greenwich meridian for every tenth day throughout the year. The introduction explains how to make allowance for a different longitude and for the change of the stars' positions by precession. Distances, position angles, magnitudes, and colors are given for double stars, and many interesting notes on the various other objects catalogued. Following this list for very small telescopes are about two hundred objects which can be seen with refractors of from four to seven inches aperture.

Perhaps the most useful part of the book is the list of two hundred and fifty test objects, divided into eight groups suitable for testing the performance of refractors varying from two to seven inches in aperture. Each of these groups contains three classes; viz., 'dividing tests, defining tests, and space penetrating tests,' — all most conveniently arranged. Several pages serve as a guide for lunar excursions, and a small table gives the positions of a dozen meteor radiants : an appendix contains information on variable stars and on the comets of 1886.

We think the book will be found useful by amateurs, and it is not to be entirely despised by the professional astronomer who is often called upon to act as celestial showman. If a chart of the moon and a small star-map (even no larger than that in Engelmann's translation of Newcomb's astronomy) had been added, it would save the trouble of frequent reference to other volumes. The price of the 'Star-guide,' we understand, is five shillings.

The star-guide: a list of the most remarkable celestial objects visible with small telescopes, with their positions for every tenth day in the year and other astronomical information. By LATIMER CLARK and HERBERT SADLER. London, *Macmillan*, 1886. 8°.

THE opening of the Euphrates valley between the Mediterranean and the Persian Gulf is one of the questions of the day, and may be regarded as complementary to the Suez Canal. If, as M. Dumont has recently pointed out to the French academy of sciences, the 1,400 kilometres which separate the Gulf of Alexandria and the Bay of Antioch from the Persian Gulf were traversed by a railway, six days would be gained in the voyage from Marseilles, Brindisi, or Salonica, to Bombay, and the hot passage of the Red Sea would be avoided. Many travellers, and also some of the more precious freight, would go by the railway. The tonnage of the Suez Canal will soon attain to 8,000,000 or 9,000,000 tons per annum ; and 200,000 passengers may be expected to traverse it in the same time. Allowing that only a quarter of the passengers and one-twentieth of the tonnage goes by the new railway, M. Dumont remarks that this proportion would justifiy the making of the new line. The local traffic would also be considerable between Bagdad and the Gulf and other places. The nature of the ground presents no great engineering difficulties. The line would rise from the mouth of the Orontes near the ancient port of Salcuces, ascend the Alep to a height of four hundred and eighty metres, and descend towards the Gulf by way of Bagdad. M. Dumont estimates the total expense of construction at 250,000,000 francs. The scheme of M. Dumont is very interesting, especially after the report of Colonel Chesney to the English government; and the railway would doubtless be attended by the opening-up of the plains of Mesopotamia, which, by irrigation and cultivation, might be made to recover their ancient fertility. Some 2,000,000 acres of land would thus be recovered to civilization.

— *The housekeeper*, Minneapolis, Minn., was burned out for the second time in six years, April 12, and a part of its large subscription list destroyed, several of the ladies employed barely escaping with their lives. Such of our readers as do not receive the May number promptly, should write to the publishers, giving full address, time when subscription was made, and length of time paid for. The May number will then be fowarded, and the name restored to the list.